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POSTPRINT



TRANSPORTABLE WASTE-TO-ENERGY SYSTEM (TWES) ENERGY RECOVERY FROM BARE BASE WASTE

Mikel L. Sawyer

**Applied Research Associates
P.O. Box 40128
Tyndall Air Force Base, FL 32403**

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**AIRBASE TECHNOLOGIES DIVISION
MATERIALS AND MANUFACTURING DIRECTORATE
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139 BARNES DRIVE, SUITE 2
TYNDALL AIR FORCE BASE, FL 32403-5323**

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Transportable Waste-to-Energy System (TWES)

Energy Recovery from Bare Base Waste



Air Force Research Laboratory
Airbase Technologies Division
(AFRL/RXQ)
Tyndall Air Force Base, Florida



Nov. 2007

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 Transportable Waste-to-Energy Sys. **AFRL**
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Objectives & Technologies

- Novel design → initial prototype testing indicates low pollution emissions
- Refine design to insure stable, long-term operation and minimize power requirements
- Characterize & incorporate system to shred bulk waste
- Air-transportable size & weight

Description

A furnace to combust shredded solid waste at domestic & deployed bases: Currently, trash such as wood, paper, plastic, tires, etc. are removed and/or partially burned. Instead the furnace, coupled with a shredder, will completely burn the waste and provide heat for water or other needs.

Payoff

- Reduce trash removal requirements at deployed military bases – Improved security
- Convert trash to heat at home & abroad to heat water for heating, showers, cleaning equipment; absorption A/C
- Potential for cleaning UXO with direct heat or steam
- Potential for neutralizing chem/bio weapons

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IMAGE: “Furn Trailer Painted 2007_2.JPG”



Bare-Base Need for TWES



- Trash *OR* Fuel!

- Shipping materials: pallets, plastic wrap, foam pellets, cardboard boxes, etc.
- Worn-out supplies: clothing, tents, wooden or plastic building materials
- Daily trash: disposable dishes, water bottles, MRE containers, old documents,
- Maintenance waste streams: dirty fuel, oil, liquid solvents.



solid waste production in Balkins

Combustable Waste 5,620 lb/soldier/year
US Army CERL, "Base Camp Solid Waste Characterization Study"

Airmen 1,100 airmen
Daily Production 16,924 lb/day
705 lb/hr

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Bare-Base Need for TWES



- Foreign vendors transport the trash
→ Manual inspections of garbage trucks
- Or, US personnel haul to external dump site → risk injury of scavengers
- Or, partial, smoky burning on-site.



Predicted Benefit of TWES



- For 1,100 airmen
 - 700 lb/hr solid waste produced by base
 - 20% efficiency [(Net Electricity Gen.)/(Heat Value of Waste Material)]
 - Net electricity 205 kW
 - Corresponds to 13 gal/hr in a 38% efficient MEP-12 diesel generator
- Per 1 ton of Solid Waste



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Heating Value

- Municipal Solid Waste $11,620 \text{ kJ/kg} = 5,000 \text{ Btu/lb}$ (Curlee and Das, 1991, chp4, p.181, pdf p.34)
- No. 2 Fuel Oil $45,263 \text{ kJ/kg}$



Background - Waste-to-Energy

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- Many County Governments sponsor Waste-to-Energy recycling facilities.
 - W-to-E is simplified way to get most value from unwanted trash
 - Recycling requires greater sorting and additional energy input



Bay County, Florida



Miami-Dade County, Florida



*Deployable Furnace System
Bare-Base Application*



- **Potential Uses of Heat**

- Heat water for showers, laundry, dishes
- Heat facilities
- Steam clean equip., engines
- Produce electricity; Absorption cooling



Water heater fueled by JP-8



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TWES Fuel Processing





Furnace System for TWES



- Furnace “FURN” has been built and tested.



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IMAGE: “Furn Trailor Painted 2007_2.JPG”



Deployable Furnace System Design

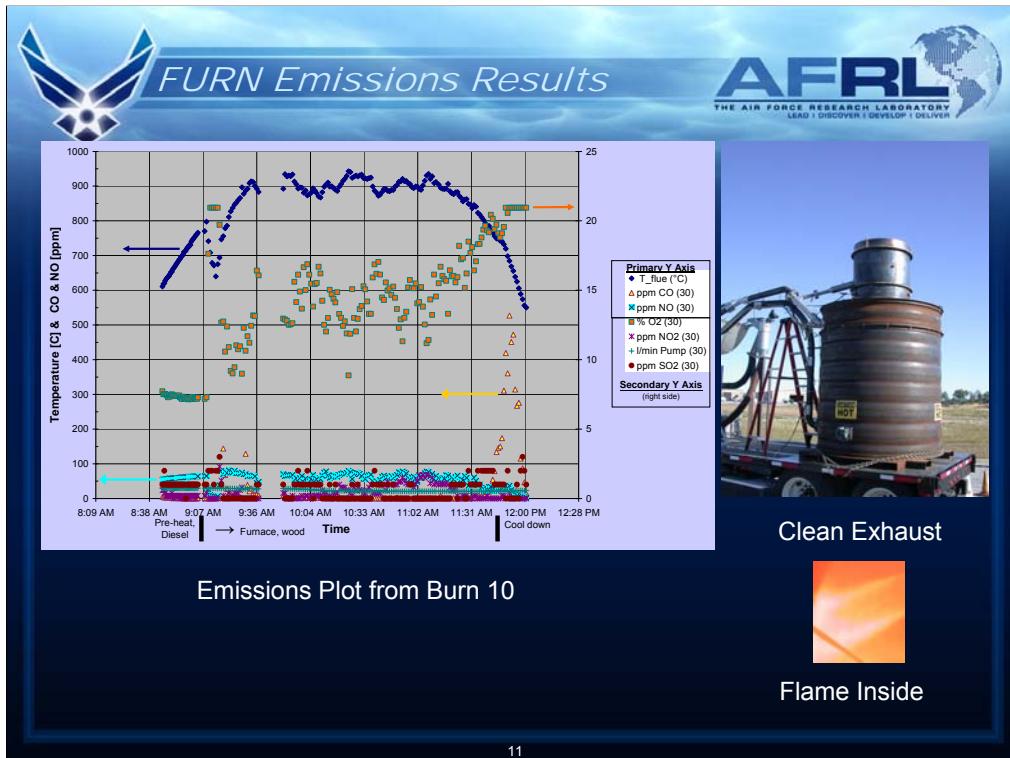


Target Operating Conditions

Feed rate	100 to 500 lb/hr = 45 to 227 kg/hr
Heat Content	$\pm 11,620 \text{ kJ/kg}$
Material bulk density	5 to 8 lb/ft ³ , 80 to 130 gm/Liter
Volumetric flow of solids	20 to 100 ft ³ /hr = 9.5 to 47 L/min (based on 5 lb/ft ³)
Particle size	3/8" in all dimensions and smaller, including dust
Total Airflow	145 to 730 SCFM, = up to 20,696 SLPM, to match the feed rates.

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- Municipal Solid Waste $11,620 \text{ kJ/kg} = 5,000 \text{ Btu/lb}$ (Curlee and Das, 1991, chp4, p.181, pdf p.34)

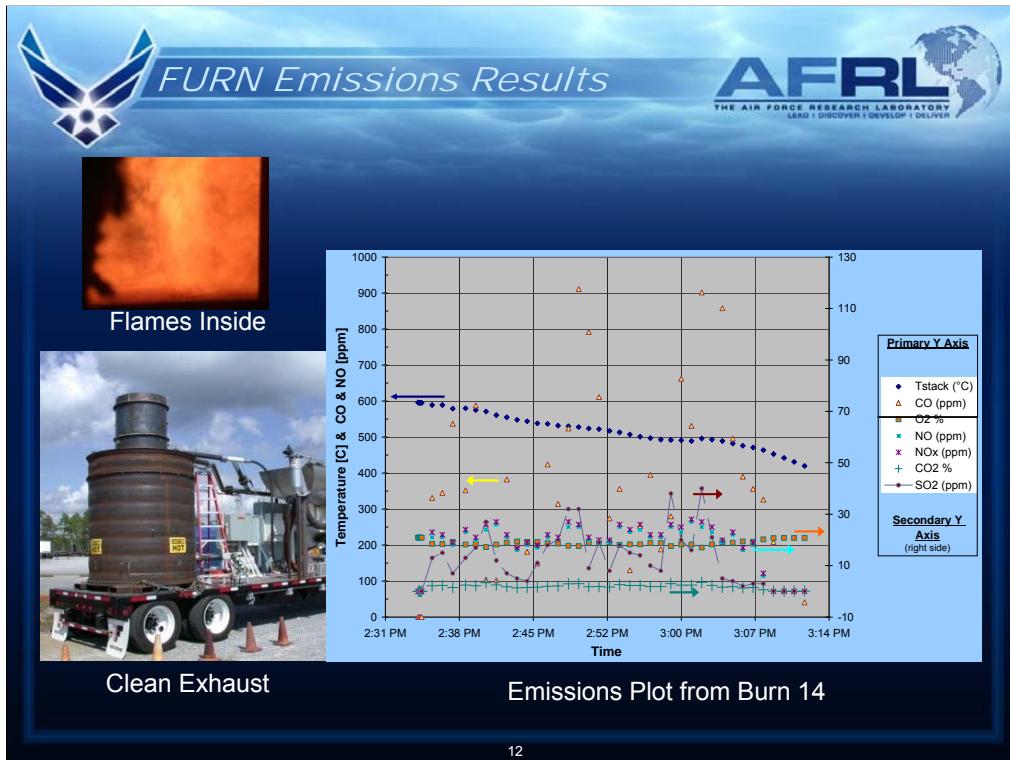


Graph from Burn 10 (~ 10:00AM)

Emissions limits from EPA and/or FDEP may be added later.

IMAGES: (1) Burn 07 outside, clean exhaust: “small_Furn Burn07 3_37PM Outside and invisible exh.JPG”

(2) Burn 13, inside bright flame “cropped_Furn Burn 13 02_55PM 1.JPG”

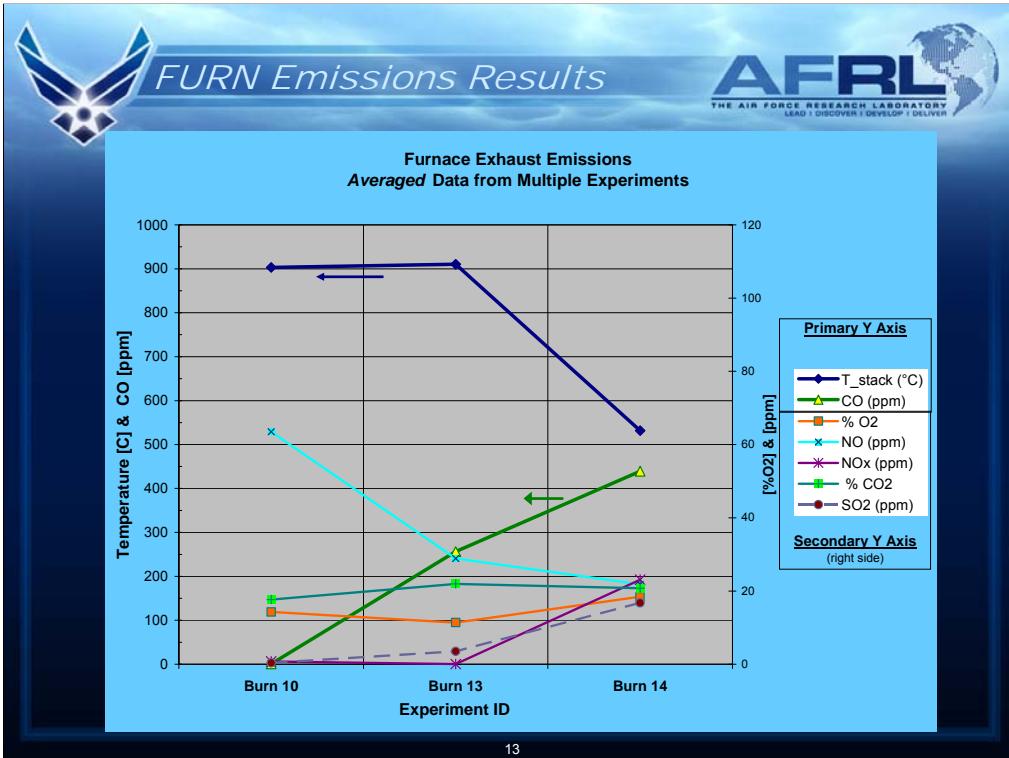


Graph from Burn 14

Emissions limits from EPA and/or FDEP may be added later.

IMAGES: (1) Burn 13 inside furnace: “small_Furn Burn 13 02_27PM 2.JPG”

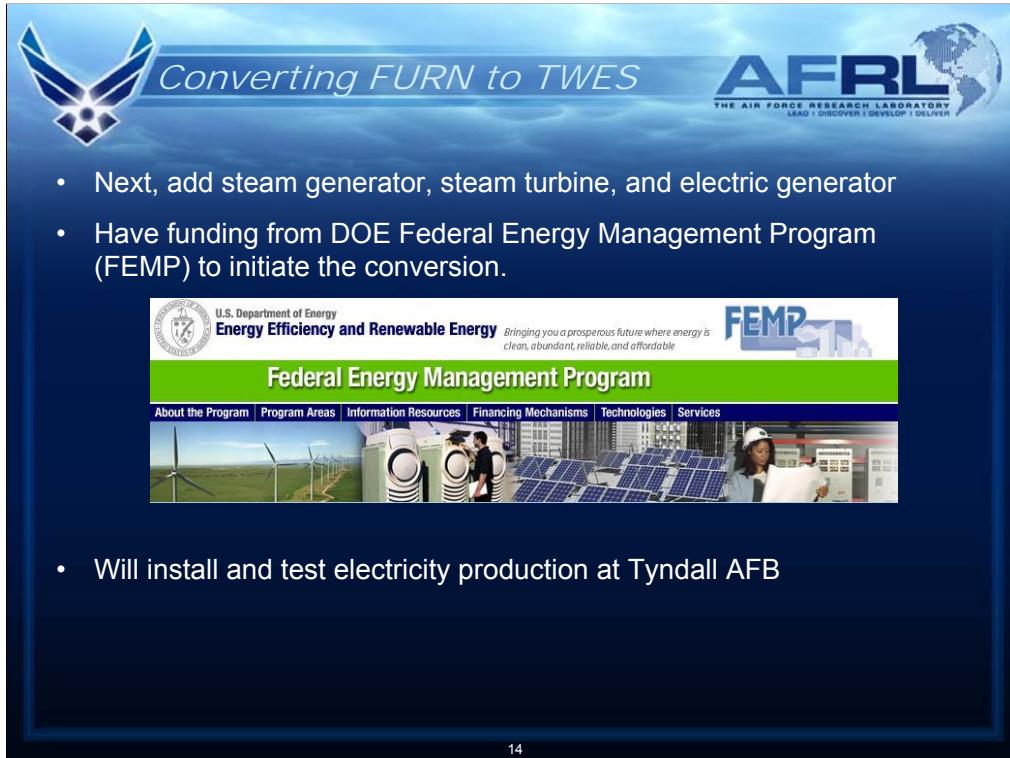
(2) Burn 08 outside, most of trailer, clean exhaust “small_Burn08 12_06pm furn trailer clean exhaust.JPG”



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Averaged emissions results from Burn 10, Burn 13, and Burn 14. Averaging usually occurred over a period of 20 to 35 minutes.

Emissions limits from EPA and/or FDEP may be added later.



The slide features the Air Force Research Laboratory (AFRL) logo at the top left, which includes the Air Force symbol and the text "Converting FURN to TWES". To the right is the AFRL logo with the tagline "THE AIR FORCE RESEARCH LABORATORY LEAD | DISCOVER | DEVELOP | DELIVER". Below the logos is a screenshot of the Federal Energy Management Program (FEMP) website. The header of the website includes the U.S. Department of Energy logo, the text "U.S. Department of Energy Energy Efficiency and Renewable Energy", and the tagline "Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable". The main title "Federal Energy Management Program" is centered above a navigation bar with links to "About the Program", "Program Areas", "Information Resources", "Financing Mechanisms", "Technologies", and "Services". Below the navigation bar are three images: wind turbines, industrial tanks, and solar panels.

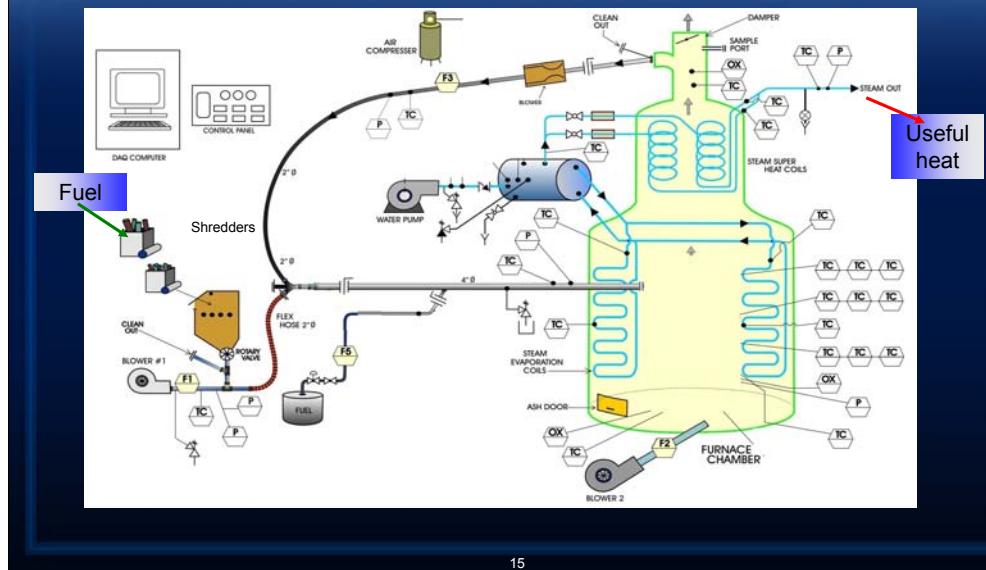
- Next, add steam generator, steam turbine, and electric generator
- Have funding from DOE Federal Energy Management Program (FEMP) to initiate the conversion.

- Will install and test electricity production at Tyndall AFB



TWES Process Diagram

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TWES Research @ Tyndall AFB



Dr. Mikel Sawyer

contractor with ARA, Inc.

Air Force Research Lab, Airbase Tech. Div. (AFRL/RXQ)

(850) 283-3725; Mike.Sawyer.ctr@tyndall.af.mil

Sunrise at Tyndall AFB

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IMAGE “small_ Furn Burn 02_001 sunrise.JPG”